Town of North Topsail Beach
North Carolina

North Topsail Beach Shoreline Protection Project

Photograph provided by Aerophoto (Feb. 20, 2013).

Beach Maintenance Plan

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Prepared By:
Coastal Planning & Engineering of North Carolina, Inc.
4038 Masonboro Loop Road
Wilmington, NC 28409

EXECUTIVE SUMMARY

The Town of North Topsail Beach is committed to a management program for a shoreline protection project along the Town's 11.1 miles of oceanfront. The program has been established to document construction achievements and monitor project performance. The need for periodic nourishments will be evaluated through the program's results. Adjacent areas, such as Onslow Beach, will also be monitored to determine if potential impacts occur. Records of the monitoring are also required for federal aid eligibility under the Public Assistance (PA) program.

The management program defines the anticipated construction sequence and the estimated financial obligations required for the project. The first of five (5) proposed phases was completed in February 2013. New River Inlet was realigned to lessen the erosion stress on North Topsail Beach. The realigned position has historically been a key component to a stable shoreline for this area.

The remaining phases are expected to be built during the 2013-2014 dredge season. The anticipated cost is approximately $27 million for placement of an estimated 2.6 million CY. Because the New River Inlet realignment occurred during the 2012-2013 dredge season, the channel will not be available as a borrow source. Inlet dredging is prohibited on less than a four (4) year maintenance interval. All material anticipated to complete the project is expected to come from an offshore borrow area. The Town has obtained permit approval for a site with adequate volume to complete the beach fill.

The project design specifies a berm elevation of +6 NAVD88 and seaward slope of 1V:15H. The berm width varies based on the volume requirements. Areas within Phase 2 and 3 contain nearshore hardbottom and require coarse fill material to avoid covering the resource. To construct these areas during the 2013-2014 season the berm width proposed for construction is 50 ft. to maximize the sand resources. The allotment of coarse material identified in the offshore borrow area provides adequate volume to complete this design. The remaining phases may receive any of the material authorized in the permit.

Nourishment requirements are estimated at 584,000 CY every four years for phases 1 through 4. Phase 5 is not expected to be renourished as part of the Town's project. USACE is anticipated to assume responsibility of maintaining Phase 5 as part of a federal authorization. Maintenance dredging of New River Inlet should afford a sufficient sediment supply for the nourishment activities. If maintenance of New River Inlet does not provide sufficient material to maintain the beach fills, additional material is available from the permitted offshore borrow area. In addition, both North Topsail Beach and Onslow County are exploring options to place material from federally authorized navigation channels on North Topsail Beach.

Project performance will dictate the necessary nourishment requirements and schedule. A monitoring protocol is established in this management program to evaluate the performance measures. Shoreline migration and volumetric trends will be calculated during each monitoring event. Shoaling of the ocean bar channel in New River Inlet will also be determined. This will enable the Town to estimate future quantities of material available for nourishment and plan events accordingly.

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INTRODUCTION

The Town of North Topsail Beach is engaged in a maintenance program to monitor and preserve their shoreline protection project. The maintenance program delineates the funding requirements and monitoring protocols for the initial project and subsequent nourishments. The plan may be amended as required to reflect changes in the project scheduling or fiscal projections.

The restoration is a management initiative to protect the infrastructure and tourist based economy along the Town's 11.1 miles of beachfront. The project will be instituted on a phased schedule with the initial work completed during the 2012 – 2013 dredge season. Supplemental phases will be implemented as funding allows with nourishments planned on a four (4) year average interval. Material will be placed within a template of specified elevation, width and slope to produce an engineered beach capable of maintaining the shoreline through the design life.

Documentation of the construction and subsequent monitoring events will be archived as evidence of the Town's commitment towards preserving the shoreline. This information is required for eligibility under the Public Assistance (PA) program administered by FEMA. If the project is impacted by a presidentially declared disaster or emergency, justification the maintenance plan has been implemented must be provided to receive federal aid. This stipulation is mandated by 44 CFR 206.226(j)(2), which states:

> *Work on an improved beach may be eligible under the following conditions:*
> *(i) The beach was constructed by the placement of sand (of proper grain size) to a designed elevation, width, and slope; and,*
> *(ii) A maintenance program involving periodic renourishment of sand must have been established and adhered to by the applicant.*

The amount of sand replacement eligible for FEMA funding is limited to the material volume lost as a result of the declared disaster or emergency. Surveys collected during the monitoring can be used to determine the pre-storm condition.

PHASE IDENTIFICATION

The shoreline restoration project was originally split into five construction phases to be completed approximately 2 years apart. Each phase involved the construction of a separate section of the beach.. The section to be constructed during each phase is defined by baseline stations established by USACE. The phases are numbered 1 through 5. The geographic location of each phase is shown on Figures 1 through 3 and is also listed by reference stations below.

- Phase 1 – Stations 1163+00 – 1090+00
- Phase 2 – Stations 1090+00 – 968+30
- Phase 3 – Stations 900+00 – 785+00
- Phase 4 – Stations 968+30 – 900+00
- Phase 5 – Stations 785+00 – 581+80

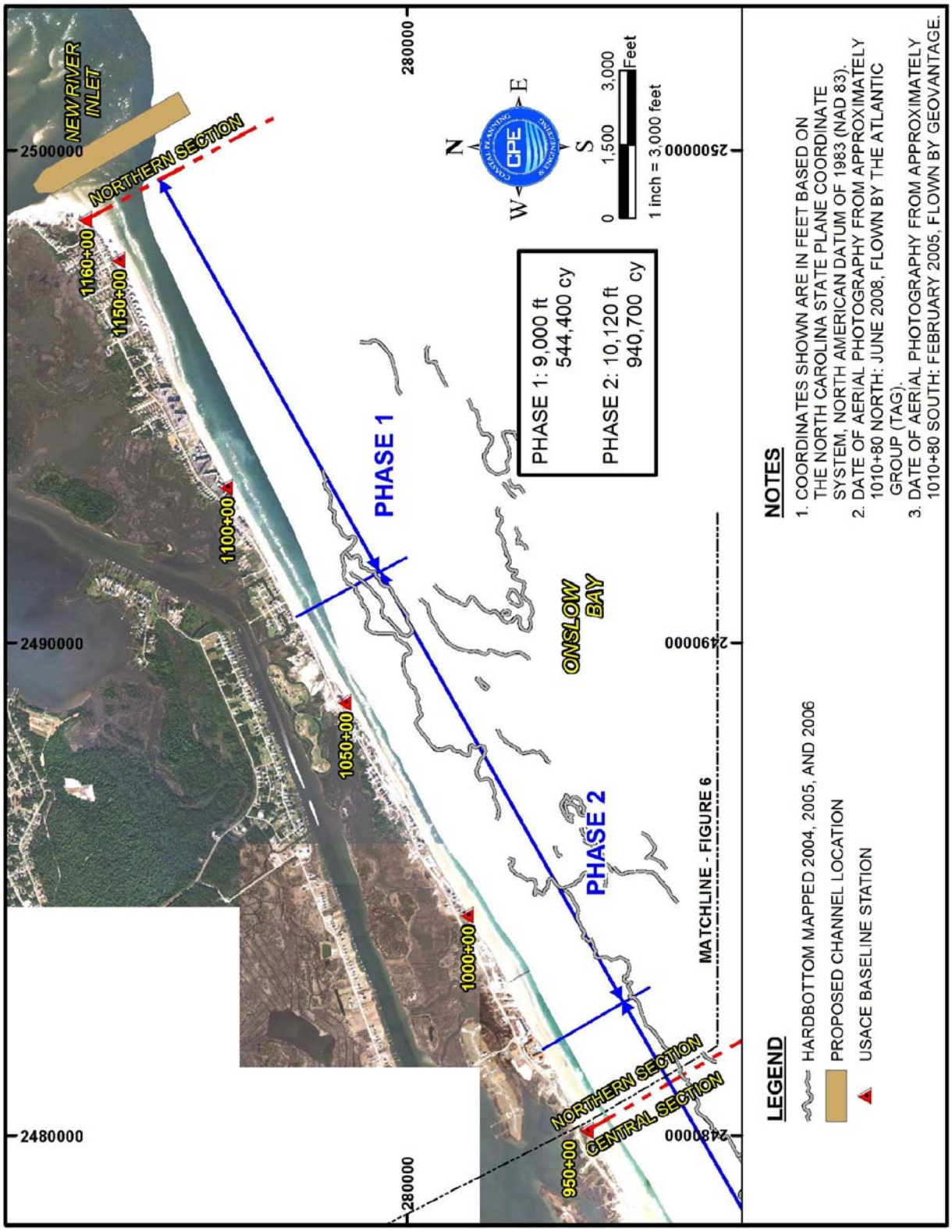

Figure 1: Project Limits for Phase 1 & 2

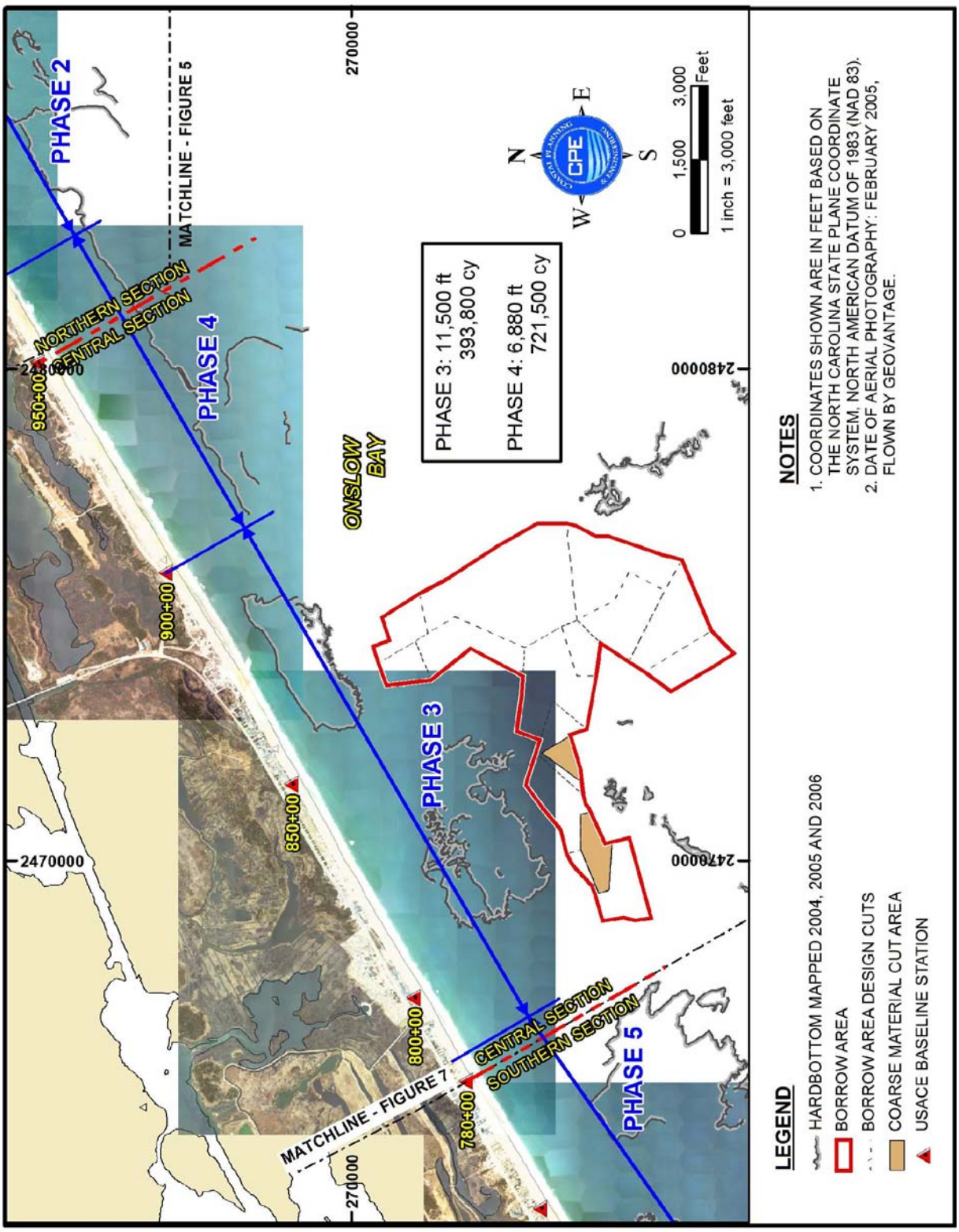

Figure 2: Project Limits for Phase 3 & 4

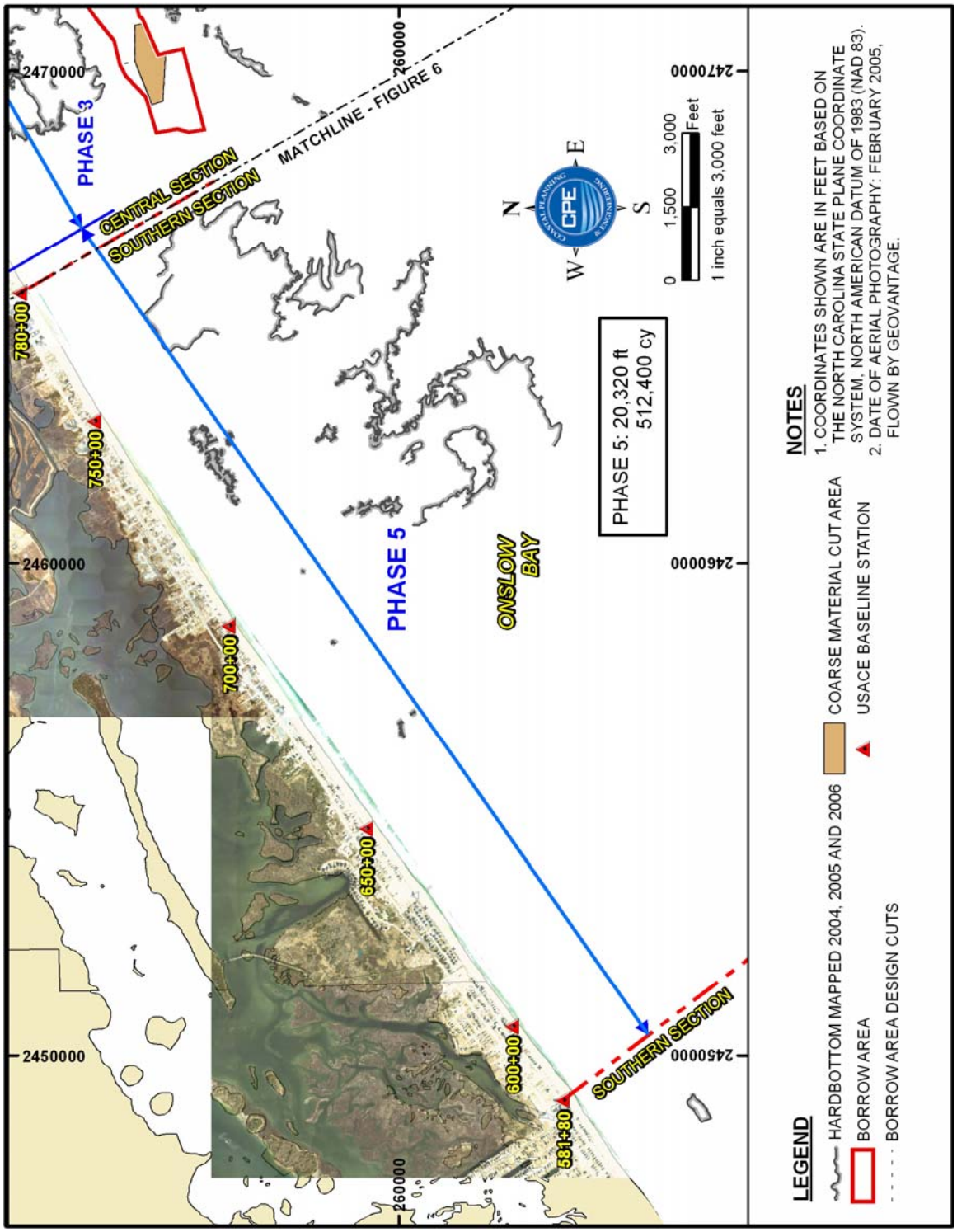

Figure 3: Project Limits for Phase 5

Phase 1, which was completed in February 2013, entailed mechanically realigning New River Inlet to provide natural protection against strong tidal currents and offshore wave energy. Beach compatible material dredged to conduct the realignment was used to restore approximately 7,700 feet of shoreline extending south from New River Inlet. Regulatory requirements prohibit the dredging of the inlet more frequently than once every 4 years (USACE, 2011). Other thresholds that must be met prior to a maintenance event include the following:

- 85% of the initial dredged volume must have shoaled back into the channel footprint; or,
- The channel thalweg must have migrated outside the 500 foot wide initial construction corridor.

The remaining phases are straight forward beach restorations. Material may be obtained from an offshore borrow area or from maintenance of New River Inlet, if the above conditions are satisfied. The only caveat is coarse material from either source must be utilized between stations 1020+00 – 1090+00 and 840+00 – 900+00 due to nearshore hardbottom. The hardbottom is located within the 500 meter buffer zone mandated by North Carolina Administrative Code (NCAC) 15A 07H.0208(b)(12)(A)(iv) (OAH, 2013). However, permit specifications allow for the placement of specially identified coarse material available in either the inlet or offshore borrow area. Design calculations show if the identified coarse material is used the equilibrated profile will not impact the hardbottom (CPE-NC, 2009a).

COSTS & VOLUME REQUIREMENTS

The estimated volumetric requirements to complete Phase 2 through 5, from the southern town limits (station 581+80) to station 1090+00, are provided in Table 1 (CPE-NC, 2009a). The estimates reflect Phase 1's completion in February 2013. Material will be placed to a berm elevation of +6 NAVD88 with a 1V:15H seaward slope (CPE-NC 2009b). The berm width varies and was designed to meet the fill densities required for each station. Material to complete the project would be obtained from the offshore borrow area utilizing both the mix and coarse sand. Completion of the project is anticipated to occur during the 2013-2014 environmental dredging window which extends from November 16, 2013 to March 31, 2014.

Table 1: Original Fill Volumes (Phase 2 through 5)

Baseline Stations	Source of Fill Material	Fill Density (cy/lf)	Total Volume (CY)
785+00 to 840+00	Offshore Mix	73.0	401,500
840+00 to 900+00	Offshore Coarse	25.7	154,100
900+00 to 968+80	Offshore Mix	104.9	721,500
968+80 to 1020+00	Offshore Mix	132.6	378,900
1020+00 to 1090+00	Offshore Coarse	57.6	403,300
581+80 to 785+00	Offshore Mix	25.2	512,400

The volume of coarse material needed to complete the project as presented totals 557,400 CY However, only 357,000 CY of coarse material or 64% of the original design volume, is available from the offshore borrow area (CPE-NC, 2009a). Since dredging of New River Inlet to obtain

the deficit coarse material would not be allowed under existing permit conditions until 2016, the fill volumes in the two areas that require coarse material were reduced.

Reallocating the coarse fill material to construct a minimum berm width of 50 ft yields an equally distributed fill density of 25 cubic yards per linear foot (cy/lf) in the two coarse material fill areas. This would result in sand placed between 840+00 and 900+00 totaling 150,000 CY, with 175,000 CY allocated to the area from 1020+00 to 1090+00. Theoretically, there would be a balance of 32,000 CY of coarse material in the offshore borrow area that would allow for dredging inefficiencies. The revised fill volumes utilizing essentially all of the available offshore coarse material is summarized in Table 2.

The total volume for all of the shoreline reaches listed in Table 2 is 2,639,300 CY. Based on this total volume, cost estimates for completion assumed two dredges would be working in the offshore borrow area. The dredges were assumed to be of similar capacity as the dredge that performed Phase 1. The total construction time was estimated between 3.5 and 4.0 months, which would allow the work to be accomplished within the normal environmental dredging window. The fill volumes for each dredge are assumed to be one-half of the project requirements.

Table 2: Revised Fill Volumes (100% Utilization of Offshore Coarse Material)

Baseline Stations	Source of Fill Material	Fill Density (cy/lf)	Total Volume (CY)
Phase 3			
785+00 to 840+00	Offshore Mix	73.0	401,500
840+00 to 900+00	Offshore Coarse	25.0	150,000
Phase 4			
900+00 to 968+80	Offshore Mix	104.9	721,500
Phase 2			
968+80 to 1020+00	Offshore Mix	132.6	378,900
1020+00 to 1090+00	Offshore Coarse	25.0	175,000
Phase 5			
581+80 to 785+00	Offshore Mix	25.2	512,400

Based on assumptions regarding effective dredge time and impacts of wave conditions on production rates, both dredges would provide close to 380,000 CY per month. Future evaluations of cost could include consideration of hopper dredges; however, use of hopper dredges for the North Topsail Beach project would require a modification of the existing permits. When the project was formulated, the proximity of hard bottoms and underlying rock formations near the offshore borrow area led to the decision to limit the work to pipeline dredges. Turtle takes were also a consideration. If these issues could be overcome in a permit mod request, the work could possibly be accomplished using a combination of pipeline and hopper dredges. Note the production rate for the Liberty Island (hopper dredge) during construction of the Nags Head project was approximately 488,000 cy/month. Recently, the hopper dredges Padre Island and Dodge Island worked a combined 35 days and delivered 284,800 CY to Reach 1 of the Bogue Banks Hurricane Irene restoration project. Based on this, the equivalent production rate for one dredge would be approximately 243,000 cy/month. Assuming permits could be obtained to

allow a hopper dredge to work between 1 January and 31 March, a pipeline dredge supplemented by a hopper dredge may provide some reduction in cost.

Another potential source of borrow material that could potentially provide some cost savings is the upland disposal area designated as DA 143 by the USACE. DA 143 has a reported 1.94 million cubic yards of beach compatible material. However, due to the relatively small mean grain size of the DA 143 material, its use would be limited to the shoreline sections that do not require coarse material. Preliminary cost estimates for use of 1.0 million cubic yards of the DA 143 material with the balance of the material obtained from the offshore borrow site indicated some slight cost savings, however, the use of DA 143 has not been permitted. Obtaining permits for DA 143 would require some time as well as additional cost. At this time (April 2013), there does not appear to be enough time to obtain a permit to allow use of DA 143 during the 2013-2014 dredging window.

Table 3: Initial Construction Estimate - Phase 2 Through 5 (2 Cutter-head Dredges)

Item	Unit	Quantity	Unit Cost	Total Cost	Cost including 15% contingency
Dredging from Offshore Borrow Area					
Dredge 1 – Construct project between 581+80 and 924+00					
Mob & Demob	Job	1	$2,237,000	$2,237,000	$2,253,300
Dredging	CY	1,315,700	$6.80	$8,947,000	$10,592,000
Dredge 2 – Construct project between 924+00 and 1090+00					
Mob & Demob	Job	1	$2,192,000	$2,192,000	$2,521,300
Dredging	CY	1,323,600	$7.25	$9,596,000	$11,035,000
Subtotal				$22,972,000	
Contingencies (15%)				$3,446,000	
Total Constr. Cost				**$26,418,000**	**$26,418,000**
E&D[(1)]				$153,000	$153,000
S&I[(2)]				$245,000	$245,000
Total				**$26,816,000**	**$26,816,000**

[(1)]Engineering and Design (i.e., Plans and Specifications)
[(2)]Supervision and Inspection (Construction oversight)

RENOURISHMENT REQUIREMENTS

Renourishment volumes needed to maintain the project are estimated at 584,000 CY every four years for Phases 1 through 4 (CPE-NC, 2009a). Phase 5 is not anticipated to be renourished as part of the Town's project. Inclusion of Phase 5 in the shoreline project was only intended as an interim step until USACE commenced with a federal project covering the same shoreline. The necessary volume may need to be revised if the federal project is delayed beyond the time where renourishment is needed on Phase 5.

Most if not all of the periodic nourishment material would be derived from maintenance of the recently completed new bar channel in New River Inlet and normal maintenance of the crossing between New River and the Atlantic Intracoastal Waterway. Shoaling of the New River Inlet channel was estimated at 627,000 CY every 4 years. Maintenance dredging of the crossing between the New River and the Atlantic Intracoastal Waterway, which has been performed by the Corps of Engineers, historically averages 48,000 cubic yards/year. This equates to

approximately 192,000 CY every 4 years. Thus, over a 4-year period, shoaling of the new channel in New River Inlet and Cedar Bush Cut would total 819,000 CY or an average of approximately 205,000 cubic yards/year.

Continued maintenance of the crossing by the Corps of Engineers will depend on future federal funding, which has become problematic during recent years. If the Corps is forced to suspend maintenance of the crossing, supplemental periodic renourishment material may have to be obtained from the offshore borrow area. In this event, the finer grained offshore borrow material would only be used in areas where hardbottom resources are not present or located sufficiently offshore not to be impacted by post-nourishment fill adjustments. The coarser shoal material from New River Inlet would be primarily allocated to nourish the areas where hardbottom resources are located relatively close to shore.

The anticipated cost for renourishment is estimated at approximately $6 M per event. Assuming Phases 2 through 4 are constructed during the 2013-2014 dredging window, the first periodic nourishment would be scheduled for 2017-2018. This would satisfy the permit conditions to allow a four (4) year interval between both the inlet maintenance and the sand placement events.

MONITORING PROTOCOL

A monitoring plan will be established for each phase prior to the initiation of work in the respective area. Topographic and hydrographic surveys of the beach profile and New River Inlet ocean bar channel will be conducted to monitor project performance and potential impacts. The beach profile surveys will include the fill area and adjacent shoreline within a minimum distance of 5,000 feet. As part of the permit conditions, the adjacent shoreline on Onslow Beach will also be monitored to assess potential impacts as a condition of the permit.

Beach profile surveys will be conducted on an annual basis for two (2) years after construction and then biennially until the next periodic nourishment. Supplemental beach profile surveys may also be required following significant storm events. Surveys of the inlet are required following channel realignment/maintenance events approximately 6 months, 18 months, and 30 months after construction. Modifications to the construction plan as permitted may require modifications to the schedule discussed here. Thus, the frequency and coverage areas will be confirmed in the monitoring plan for each specific phase. The plans will be updated as needed.

Reports of each monitoring event will be archived by the Town. The reports will contain volumetric and shoreline change calculations to describe how the project is performing. Erosion rates along the beach, including shoreline migration, will be documented throughout the monitoring process. Shoaling rates within New River Inlet will also be calculated. The monitoring results will be used to identify erosion ‘hot spots’ and to estimate sediment availability for future maintenance events.

CONCLUSION

The Town of North Topsail Beach has initiated the construction of a shoreline protection project that will eventually cover its 11.1 mile ocean shoreline. The project will provide increased protection to the Town's economy and coastal development. Part of the project includes implementing a management program to document construction achievements and future performance. Anticipated future costs have been estimated and are included in the management program.

The Town initially planned to construct the project in five (5) phases as previously discussed. With the successful completion of Phase 1 in February 2013, the Town now plans to implement the remaining four phases during the 2013-2014 environmental dredging window. This schedule depends on the Town securing the necessary funding. Initial construction of the four remaining phases will require approximately 2.6 million CY of fill material at a cost presently estimated to be approximately $26 million.

Periodic nourishment or maintenance is also included in the management program. The nourishments are expected to occur on a 4 year cycle and will involve dredging of the ocean bar channel in New River Inlet. Additional material may also be supplied from the crossing of New River Inlet and the Atlantic Intracoastal Waterway (inlet crossing) or from an offshore borrow area. The maintenance of the inlet crossing would most likely be conducted by USACE and is subject to federal funding. However, the Town holds the state and federal permits for dredging of New River Inlet and the offshore borrow area. Estimates showed a total of 627,000 CY are anticipated to be available from maintenance of the new bar channel in New River Inlet every four years. The volume of material required to replenish the design template was estimated at 584,000 CY every four years. Therefore, maintenance of New River Inlet may provide the necessary volume to maintain the project after the initial construction.

Project monitoring will be implemented to track performance of the placed material and will be used to update nourishment requirements. Monitoring will begin at the completion of the initial construction for each respective phase. A specific plan will be developed to document the monitoring tasks required prior to any construction event. The plan may be updated throughout the monitoring phase to reflect any deviation from the current protocol. Surveys of the beach profile and New River Inlet ocean bar channel will be conducted to capture changes along the shoreline and within the inlet channel. The surveys will also depict how the realignment of New River Inlet is performing and if any potential impacts to adjacent shoreline are occurring.

The management program will provide a written record of the activities conducted to maintain the shoreline protection project. The results will help in future planning and may also help to secure federal assistance in the event of a major storm. Verification that a management program has been instituted is required prior to receiving FEMA assistance for a declared disaster or emergency. Results of the management program must be reviewed by federal officials to ascertain eligibility allowances for applicants requesting federal aid.

REFERENCES

CPE-NC (2009a) Engineering analysis; shoreline protection project; Town of North Topsail Beach, North Carolina. Wilmington.

CPE-NC (2009b) North Topsail Beach shoreline protection project; final environmental impact statement. Wilmington.

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USACE, (2011) Department of the army permit SAW 2005-00344. Wilmington